CLAIMS

1. A pulsatile blood pumping system comprising:

   a housing having a wall defining a generally spherical interior, said housing having at least one intake port opening in communication with said interior of said housing and at least one discharge port opening in communication with said interior of said housing, comprising:

   a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through the housing wall;

   at least one primary vane disposed within said interior of said housing that rotates about said primary axis of said first shaft;

   at least one secondary vane disposed within the interior of said housing and mounted to said primary vane on a first pivotal axis, said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane and defining at least a chamber within said housing interior having a volume which varies as said primary vane is rotated about said primary axis;

   wherein said at least one intake port opening and said at least one discharge port opening are connected to circulate at least one blood fluid through a living organism.

2. The pulsatile blood pumping system of claim 1 wherein materials of construction for said pulsatile blood pumping system are selected from the group consisting of Teflon, titanium, pyrolytic carbon, Dacron, heparin, and polyurethane.

3. The pulsatile blood pumping system of claim 1 wherein said secondary vane is pivotally coupled to a carrier ring, so that said secondary vane is pivotal about a second pivotal axis perpendicular to the axis of rotation of said carrier ring causing said secondary vane to reciprocate between relatively open and closed positions as said secondary vane is rotated about said primary axis by said first shaft; the axis of rotation of said carrier ring being oriented at an oblique angle in relation to said primary axis of said first shaft.

4. The pulsatile blood pumping system of claim 3 further comprising a second shaft that extends into said interior of said housing opposite said first shaft, said second shaft having a spherical portion about which said primary vane rotates and wherein said carrier ring is rotatably carried on said spherical portion of said second shaft.

5. The pulsatile blood pumping system of claim 4 wherein said first shaft is rotatably coupled to said spherical portion of said second shaft to provide rigidity to the structure.

6. The pulsatile blood pumping system of claim 5, wherein said rotatable coupling is accomplished by an extension of a portion of said first shaft into said spherical portion of said second shaft.

7. The pulsatile blood pumping system of claim 5 wherein said rotatable coupling is accomplished by an extension of a portion of said spherical portion of said second shaft into said first shaft.

8. The pulsatile blood pumping system of claim 5; wherein a fluid channel is provided through the center of said first shaft, into said spherical portion of said

second shaft, and out said second shaft, providing for a flow of lubricant and/or coolant through the interior members of said pulsatile blood pumping system.

9. The pulsatile blood pumping system of claim 4 wherein seals are installed on both primary and secondary vanes to contact said housing during operation and wherein seals are installed on both primary and secondary vanes to contact said spherical portion of said second shaft during operation.

10. The pulsatile blood pumping system of claim 4 wherein said second shaft is adjustably mounted to said housing so that said second shaft can be oriented in various fixed positions, and further comprising;

    an adjustable vane guide bearing member disposed within said housing, wherein the adjustable vane guide bearing member oscillates said secondary vane between relatively open and closed positions relative to said primary vane in response to rotation of said primary vane, varying the point during rotation of said first shaft and said primary vane at which said secondary vane reaches the relatively open and closed positions relative to said housing and said port opening so that communication of said port opening with said chamber is adjusted and therefore the fluid flow volume and/or direction is adjusted.

11. The pulsatile blood pumping system of claim 3 wherein said carrier ring is an exterior ring mounted in said wall of said housing.

12. The pulsatile blood pumping system of claim 1 wherein a flow pulse profile created by said pulsatile blood pumping system is adjusted through the use of a flow element that is resistive and/or capacitive in nature, said flow element being in communication with said pulsatile blood pumping system.

13. The pulsatile blood pumping system of claim 1 wherein the flow rate through said at least one discharge port opening of said pulsatile blood pumping system is adjusted based on feedback from sensors in said living organism.

14. The pulsatile blood pumping system of claim 13 wherein said sensor senses flow pulsations of at least one of the heart ventricles of said living organism and adjusts said rotational speed of said first shaft to coincide pulsatile flow of said pulsatile blood pumping system with said flow pulsations of said heart ventricle.

15. The pulsatile blood pumping system of claim 13 wherein said sensor senses flow demand of at least one of the heart ventricles of said living organism and adjusts said rotational speed of said first shaft to match said flow demand.

16. The pulsatile blood pumping system of claim 1 wherein the diameter of said generally spherical interior and the typical rotation rate of said primary shaft are sized to provide both a flow level and flow pulsation frequency that correspond with the flow and pulsation needs of the intended recipient.

17. The pulsatile blood pumping system of claim 1 wherein said pulsatile blood pumping system is implanted into the body of said living organism.

18. The pulsatile blood pumping system of claim 17 wherein said pulsatile blood pumping system is attached to the bones, muscles, sinews and/or internal organs of said living organism.

19. The pulsatile blood pumping system of claim 17 wherein the exposed surfaces in said pulsatile blood pumping system are porous to promote ingrowth of host cells to further anchor and provide biocompatibility within said living organism.

20. The pulsatile blood pumping system of claim 17 wherein a motor to rotate said first shaft is connected directly to said first shaft and fixedly mounted to said housing.

21. The pulsatile blood pumping system of claim 17 wherein a detached motor to rotate said first shaft is mechanically and/or electromagnetically linked to said first shaft.

22. The pulsatile blood pumping system of claim 17 wherein the power to rotate said first shaft is supplied transcutaneously.

23. The pulsatile blood pumping system of claim 22 wherein power to rotate said first shaft is supplied transcutaneously by radio frequency power transmitted across skin to a receiving coil.

24. The pulsatile blood pumping system of claim 22 wherein power to rotate said first shaft is transmitted via magnets coupled across skin surface.

25. The pulsatile blood pumping system of claim 21 wherein said pulsatile blood pumping system is implanted in chest cavity of living organism and said detached motor is implanted in abdominal cavity.

26. The pulsatile blood pumping system of claim 1 wherein said pulsatile blood pumping system is located outside the body of said living organism.

27. The pulsatile blood pumping system of claim 26 wherein a motor to rotate said first shaft is connected directly to said first shaft and fixedly mounted to said housing.

28. The pulsatile blood pumping system of claim 26 wherein a motor to rotate said first shaft is mechanically and/or electromagnetically linked to said first shaft, but physically detached from said housing.

29. The pulsatile blood pumping system of claim 26 wherein said at least one intake port opening and said at least one discharge port openings are accomplished by changeable port inserts.

30. The pulsatile blood pumping system of claim 29 wherein said changeable port inserts are eccentric in shape.

31. The pulsatile blood pumping system of claim 3 wherein clearances smaller than the diameter of a red blood cell are maintained between said carrier ring and said spherical portion or said housing.

32. The pulsatile blood pumping system of claim 1 wherein at least one blood-contacting surface of said pulsatile blood pumping system is selected from the group consisting of heparin, acetylsalicylic acid and derivatives of any of the foregoing.

33. The pulsatile blood pumping system of claim 1 wherein at least one additive to blood flowing through said pulsatile blood pumping system is selected from the group consisting of heparin, acetylsalicylic acid and derivatives of any of the foregoing.

34. The pulsatile blood pumping system of claim 4 wherein a fluid channel is provided through the center of said first shaft, into said spherical portion of said second shaft, and out said second shaft or out said first shaft, providing for a flow

of a flushing medium through the interior members of said pulsatile blood pumping system.

35. The pulsatile blood pumping system of claim 34 wherein said flushing medium contains blood.

36. The pulsatile blood pumping system of claim 34 wherein said flushing medium contains blood plasma.

37. The pulsatile blood pumping system of claim 1 wherein at least one blood-contacting surface of said pulsatile blood pumping system is provided shaping to reduce shear forces on said blood fluid as it is circulated through said pulsatile blood pumping system.

38. The pulsatile blood pumping system of claim 37 wherein said shaping is provided on one of said vanes of said pulsatile blood pumping system.

39. The pulsatile blood pumping system of claim 38 wherein said shaping includes a groove in the surface of said vane wherein the direction of said groove near a given point on said vane is substantially aligned with the most direct path between said point on said vane and at least one of said ports of said pulsatile blood pumping system.

40. The pulsatile blood pumping system of claim 38 wherein said shaping includes constructing a first surface on a first of said vanes and a second surface on a second of said vanes, wherein said first and second surfaces are facing each other, in such a way that the first gap at a first point is greater than the second gap at a second point, wherein said first point is located on said first surface of said first vane and is nearer to a port than said second point which is also located

on said first surface of said first vane, and wherein said first and second gaps are defined as the distance between respective said points and their nearest proximal points on said second surface of said second vane.

41. The pulsatile blood pumping system of claim 37 wherein said shaping includes a curvilinear transition between said generally spherical interior of said housing and an interior surface of one of said ports.

42. The pulsatile blood pumping system of claim 1 wherein a first fluid and a second fluid flow through the pulsatile blood pumping system.

43. The pulsatile blood pumping system of claim 42 wherein said first fluid is oxygen rich blood and said second fluid is oxygen poor blood.

44. The pulsatile blood pumping system of claim 42 wherein said first fluid is used to power said pulsatile blood pumping system and said second fluid is pumped.

45. The pulsatile blood pumping system of claim 42 wherein said first fluid and said second fluid are given two different flow rates.

46. The pulsatile blood pumping system of claim 45 wherein said first fluid flows to, assists, or replaces the flow of the left ventricle of said living organism and said second fluid flows to, assists, or replaces the flow of the right ventricle of said living organism and wherein said first fluid is provided a higher flow rate than said second fluid.

47. The pulsatile blood pumping system of claim 45 wherein said two different flow rates are provided by rotating port openings to new fixed positions relative to said primary axis.

48. The pulsatile blood pumping system of claim 45 wherein said two different flow rates are provided by altering the shape or face angle of one or more vanes.

49. The pulsatile blood pumping system of claim 45 wherein said two different flow rates are provided by provision of a relatively one-way flow path between fluid chambers.

50. The pulsatile blood pumping system of claim 49 wherein said relatively one-way flow path between fluid chambers is accomplished via a flow path around a vane.

51. The pulsatile blood pumping system of claim 49 wherein said relatively one-way flow path between fluid chambers is accomplished via a flow path through a vane.

52. The pulsatile blood pumping system of claim 42 wherein a first fluid stream is provided communication with said at least one intake port opening and a second fluid stream is provided communication with said at least one discharge port opening, said first and second fluid streams providing flow to and from said pulsatile blood pumping system for said first fluid, and a third fluid stream is provided communication with a second intake port opening in said housing and a fourth fluid stream is provided communication with a second discharge port opening in said housing, said third and fourth fluid streams providing flow to and from said pulsatile blood pumping system for said second fluid.

53. The pulsatile blood pumping system of claim 1 wherein a first fluid stream is provided communication with said at least one intake port opening and a second intake port opening and a second fluid stream is provided communication with said at least one discharge port opening and a second discharge port opening,

said first and second fluid streams providing flow of said blood fluid to and from said pulsatile blood pumping system.

54. The pulsatile blood pumping system of claim 1 wherein seals are provided between relatively moving surfaces in said pulsatile blood pumping system to limit the flow of said blood fluid between said relatively moving surfaces.

55. The pulsatile blood pumping system of claim 1 wherein said secondary vane is adjusted in weight or density so as to provide momentum near the relatively closed position with respect to said primary vane that balances the force exerted upon said secondary vane by the fluid pressurized in said at least one chamber.

56. The pulsatile blood pumping system of claim 1 wherein said volume of said at least one chamber approaches near zero with each cycle between relatively open and closed positions of said at least one chamber, for the substantially complete expulsion of said blood fluid from said at least one chamber with each cycle.

57. A method for circulating at least one blood fluid through a living organism in a pulsatile manner comprising the steps of:

providing a housing having a wall defining a generally spherical interior, the housing having at least one intake port opening in communication with said interior of said housing and at least one discharge port opening in communication with said interior of said housing through which said at least one blood fluid flows;

connecting said at least one intake port opening and said at least one discharge port opening to enable the circulation of said at least one blood fluid through said living organism;

rotating a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through said housing wall;

rotating at least one primary vane disposed within the interior of the housing that rotates about said primary axis;

providing at least one secondary vane disposed within the interior of the housing and mounted to said primary vane on a first pivotal axis; and

rotating said primary vane about said primary axis with said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane, the housing, the primary vane, and the secondary vane defining a at least one fluid chamber for containing fluid within the housing interior having a volume that varies as the primary vane is rotated about the primary axis.

58. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein materials of construction for said pulsatile blood pumping system are selected from the group consisting of Teflon, titanium, pyrolytic carbon, Dacron, heparin, and polyurethane.

59. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said secondary vane is pivotally coupled to a carrier ring, so that said secondary vane is pivotal about a second pivotal axis perpendicular to the axis of rotation of said carrier ring causing said secondary vane to reciprocate between relatively open and closed positions as said secondary vane is rotated about said primary axis by said first shaft; the axis of

rotation of said carrier ring being oriented at an oblique angle in relation to said primary axis of said first shaft.

60. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 59 further comprising a second shaft that extends into said interior of said housing opposite said first shaft, said second shaft having a spherical portion about which said primary vane rotates and wherein said carrier ring is rotatably carried on said spherical portion of said second shaft.

61. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 60 wherein said first shaft is rotatably coupled to said spherical portion of said second shaft to provide rigidity to the structure.

62. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 61 wherein said rotatable coupling is accomplished by an extension of a portion of said first shaft into said spherical portion of said second shaft.

63. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 61 wherein said rotatable coupling is accomplished by an extension of a portion of said spherical portion of said second shaft into said first shaft.

64. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 61 wherein a fluid channel is provided through the center of said first shaft, into said spherical portion of said second shaft, and out said second shaft, and further comprising the step of flowing a lubricant and/or coolant through the interior members of said pulsatile blood pumping system.

65. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 60 wherein seals are installed on both primary and secondary vanes to contact said housing during operation and wherein seals are installed on both primary and secondary vanes to contact said spherical portion of said second shaft during operation.

66. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 60 wherein said second shaft is adjustably mounted to said housing so that said second shaft can be oriented in various fixed positions, and further comprising;

an adjustable vane guide bearing member disposed within said housing, wherein the adjustable vane guide bearing member oscillates said secondary vane between relatively open and closed positions relative to said primary vane in response to rotation of said primary vane, varying the point during rotation of said first shaft and said primary vane at which said secondary vane reaches the relatively open and closed positions relative to said housing and said port opening so that communication of said port opening with said chamber is adjusted and therefore the fluid flow volume and/or direction is adjusted.

67. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 59 wherein said carrier ring is an exterior ring mounted in said wall of said housing.

68. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein a flow pulse profile created by said pulsatile blood pumping system is adjusted through the use of a flow element that is resistive and/or capacitive in nature, said flow element being in communication with said pulsatile blood pumping system.

69. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein the flow rate through said at least one discharge port opening of said pulsatile blood pumping system is adjusted based on feedback from sensors in said living organism.

70. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 69 wherein said sensor senses flow pulsations of at least one of the heart ventricles of said living organism and adjusts said rotational speed of said first shaft to coincide pulsatile flow of said pulsatile blood pumping system with said flow pulsations of said heart ventricle.

71. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 69 wherein said sensor senses flow demand of at least one of the heart ventricles of said living organism and adjusts said rotational speed of said first shaft to match said flow demand.

72. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein the diameter of said generally spherical interior and the typical rotation rate of said primary shaft are sized to provide both a flow level and flow pulsation frequency that correspond with the flow and pulsation needs of the intended recipient.

73. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said pulsatile blood pumping system is implanted into the body of said living organism.

74. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 73 wherein said pulsatile blood pumping system is

attached to the bones, muscles, sinews and/or internal organs of said living organism.

75. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 73 wherein the exposed surfaces in said pulsatile blood pumping system are porous to promote ingrowth of host cells to further anchor and provide biocompatibility within said living organism.

76. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 73 wherein a motor to rotate said first shaft is connected directly to said first shaft and fixedly mounted to said housing.

77. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 73 wherein a detached motor to rotate said first shaft is mechanically and/or electromagnetically linked to said first shaft.

78. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 73 wherein the power to rotate said first shaft is supplied transcutaneously.

79. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 78 wherein power to rotate said first shaft is supplied transcutaneously by radio frequency power transmitted across skin to a receiving coil.

80. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 78 wherein power to rotate said first shaft is transmitted via magnets coupled across skin surface.

81. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 78 wherein said pulsatile blood pumping system is implanted in chest cavity of living organism and said detached motor is implanted in abdominal cavity.

82. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said pulsatile blood pumping system is located outside the body of said living organism.

83. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 82 wherein a motor to rotate said first shaft is connected directly to said first shaft and fixedly mounted to said housing.

84. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 82 wherein a motor to rotate said first shaft is mechanically and/or electromagnetically linked to said first shaft, but physically detached from said housing.

85. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 82 wherein said at least one intake port opening and said at least one discharge port openings are accomplished by changeable port inserts.

86. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 85 wherein said changeable port inserts are eccentric in shape.

87. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 60 wherein clearances smaller than the diameter of a

red blood cell are maintained between said carrier ring and said spherical portion or said housing.

88. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein at least one blood-contacting surface of said pulsatile blood pumping system is selected from the group consisting of heparin, acetylsalicylic acid and derivatives of any of the foregoing.

89. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein at least one additive to blood flowing through said pulsatile blood pumping system is selected from the group consisting of heparin, acetylsalicylic acid and derivatives of any of the foregoing.

90. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 60 wherein a fluid channel is provided through the center of said first shaft, into said spherical portion of said second shaft, and out said second shaft or out said first shaft, providing for a flow of a flushing medium through the interior members of said pulsatile blood pumping system.

91. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 90 wherein said flushing medium contains blood.

92. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 90 wherein said flushing medium contains blood plasma.

93. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein at least one blood-contacting surface of the

pulsatile blood pumping system is provided shaping to reduce shear forces on said blood fluid as it is circulated through said pulsatile blood pumping system

94. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 93 wherein said shaping is provided on one of said vanes of said pulsatile blood pumping system.

95. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 94 wherein said shaping includes a groove in the surface of said vane wherein the direction of said groove near a given point on said vane is substantially aligned with the most direct path between said point on said vane and at least one of said ports of said pulsatile blood pumping system.

96. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 94 wherein said shaping includes constructing a first surface on a first of said vanes and a second surface on a second of said vanes, wherein said first and second surfaces are facing each other, in such a way that the first gap at a first point is greater than the second gap at a second point, wherein said first point is located on said first surface of said first vane and is nearer to a port than said second point which is also located on said first surface of said first vane, and wherein said first and second gaps are defined as the distance between respective said points and their nearest proximal points on said second surface of said second vane.

97. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 93 wherein said shaping includes a curvilinear transition between said generally spherical interior of said housing and an interior surface of one of said ports.

98. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein a first fluid and a second fluid flow through the pulsatile blood pumping system.

99. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 98 wherein said first fluid is oxygen rich blood and said second fluid is oxygen poor blood.

100. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 98 wherein said first fluid is used to power said pulsatile blood pumping system and said second fluid is pumped.

101. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 98 wherein said first fluid and said second fluid are given two different flow rates.

102. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 101 said first fluid flows to, assists, or replaces the flow of the left ventricle of said living organism and said second fluid flows to, assists, or replaces the flow of the right ventricle of said living organism and wherein said first fluid is provided a higher flow rate than said second fluid.

103. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 101 wherein said two different flow rates are provided by rotating port openings to new fixed positions relative to said primary axis.

104. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 101 wherein said two different flow rates are provided by altering the shape or face angle of one or more vanes.

105. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 101 wherein said two different flow rates are provided by provision of a relatively one-way flow path between fluid chambers.

106. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 105 wherein said relatively one-way flow path between fluid chambers is accomplished via a flow path around a vane.

107. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 105 wherein said relatively one-way flow path between fluid chambers is accomplished via a flow path through a vane.

108. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 98 wherein a first fluid stream is provided communication with said at least one intake port opening and a second fluid stream is provided communication with said at least one discharge port opening, said first and second fluid streams providing flow to and from said pulsatile blood pumping system for said first fluid, and a third fluid stream is provided communication with a second intake port opening in said housing and a fourth fluid stream is provided communication with a second discharge port opening in said housing, said third and fourth fluid streams providing flow to and from said pulsatile blood pumping system for said second fluid.

109. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein a first fluid stream is provided communication with said at least one intake port opening and a second intake port opening and a second fluid stream is provided communication with said at least one discharge port opening and a second discharge port opening, said first

and second fluid streams providing flow of said blood fluid to and from said pulsatile blood pumping system.

110. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein seals are provided between relatively moving surfaces in said pulsatile blood pumping system to limit the flow of said blood fluid between said relatively moving surfaces.

111. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said secondary vane is adjusted in weight or density so as to provide momentum near the relatively closed position with respect to said primary vane that balances the force exerted upon said secondary vane by the fluid pressurized in said at least one chamber.

112. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said volume of said at least one chamber approaches near zero with each cycle between relatively open and closed positions of said at least one chamber, for the substantially complete expulsion of said blood fluid from said at least one chamber with each cycle.

113. The pulsatile blood pumping system of claim 1 wherein said primary vanes and/or secondary vanes include magnetic portions that are acted upon by electromagnetic fields that are generated from within said housing wall or from outside of said housing wall, wherein said action causes said rotation of said primary vane and causes said oscillation of said secondary vanes.

114. The pulsatile blood pumping system of claim 11 wherein said external carrier ring includes magnetic portions that are acted upon by electromagnetic fields that are generated from within said housing wall or from outside of said housing wall,

wherein said action causes said rotation of said primary vane and said oscillation of said secondary vanes.

115. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said primary vanes and/or secondary vanes include magnetic portions that are acted upon by electromagnetic fields that are generated from within said housing wall or from outside of said housing wall, wherein said action causes said rotation of said primary vane and causes said oscillation of said secondary vanes.

116. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 67 wherein said external carrier ring includes magnetic portions that are acted upon by electromagnetic fields that are generated from within said housing wall or from outside of said housing wall, wherein said action causes said rotation of said primary vane and said oscillation of said secondary vanes.

117. A pulsatile blood pumping system comprising:

a housing having a wall defining a generally spherical interior, said housing having at least one intake port opening in communication with said interior of said housing and at least one discharge port opening in communication with said interior of said housing, comprising:

a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through the housing wall;

at least one primary vane disposed within said interior of said housing that rotates about said primary axis of said first shaft;

at least one secondary vane disposed within the interior of said housing and mounted to said primary vane on a first pivotal axis, said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane and defining at least a chamber within said housing interior having a volume which varies as said primary vane is rotated about said primary axis;

wherein said at least one intake port opening and said at least one discharge port opening are operated simultaneously to both input and discharge blood fluids.

118. A method for simultaneously inputting and discharging at least one blood fluid through a blood pumping system in a pulsatile manner comprising the steps of:

providing a housing having a wall defining a generally spherical interior, the housing having at least one intake port opening in communication with said interior of said housing and at least one discharge port opening in communication with said interior of said housing through which said at least one blood fluid flows;

connecting said at least one intake port opening and said at least one discharge port opening to enable the circulation of said at least one blood fluid through said blood pumping system;

rotating a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through said housing wall;

rotating at least one primary vane disposed within the interior of the housing that rotates about said primary axis;

providing at least one secondary vane disposed within the interior of the housing and mounted to said primary vane on a first pivotal axis; and

rotating said primary vane about said primary axis with said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane, the housing, the primary vane, and the secondary vane defining a at least one fluid chamber for containing fluid within the housing interior having a volume that varies as the primary vane is rotated about the primary axis.

119. A pulsatile blood pumping system comprising:

a housing having a wall defining a generally spherical interior, said housing having at least first and second intake port openings in communication with said interior of said housing, comprising:

a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through the housing wall;

at least one primary vane disposed within said interior of said housing that rotates about said primary axis of said first shaft;

at least one secondary vane disposed within the interior of said housing and mounted to said primary vane on a first pivotal axis, said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane and defining at least first and second chambers within said housing interior having volumes which vary as said primary vane is rotated about said primary axis;

wherein said first and second intake port openings are operated simultaneously to input at least one blood fluid into said first and second chambers, respectively.

120. A method for simultaneously inputting at least first and second blood fluid streams through a blood pumping system in a pulsatile manner comprising the steps of:

providing a housing having a wall defining a generally spherical interior, the housing having at least first and second intake port openings in communication with said interior of said housing through which said at least first and second blood fluid streams flow;

connecting said at least first and second intake port openings to enable the circulation of said at least first and second blood fluid streams through said blood pumping system;

rotating a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through said housing wall;

rotating at least one primary vane disposed within the interior of the housing that rotates about said primary axis;

providing at least one secondary vane disposed within the interior of the housing and mounted to said primary vane on a first pivotal axis; and

rotating said primary vane about said primary axis with said secondary vane pivotally oscillating between alternating relatively open and closed positions with

respect to said primary vane, the housing, the primary vane, and the secondary vane defining a at least first and second fluid chambers for containing fluid within the housing interior having volumes that vary as the primary vane is rotated about the primary axis, said first and second blood fluid streams being inputted into said first and second fluid chambers, respectively.

121. A pulsatile blood pumping system comprising:

a housing having a wall defining a generally spherical interior, said housing having at least first and second discharge port openings in communication with said interior of said housing, comprising:

a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through the housing wall;

at least one primary vane disposed within said interior of said housing that rotates about said primary axis of said first shaft;

at least one secondary vane disposed within the interior of said housing and mounted to said primary vane on a first pivotal axis, said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane and defining at least first and second chambers within said housing interior having volumes which vary as said primary vane is rotated about said primary axis;

wherein said first and second discharge port openings are operated simultaneously to discharge at least one blood fluid from said first and second chambers, respectively.

122. A method for simultaneously discharging at least first and second blood fluid streams through a blood pumping system in a pulsatile manner comprising the steps of:

providing a housing having a wall defining a generally spherical interior, the housing having at least first and second discharge port openings in communication with said interior of said housing through which said at least first and second blood fluid streams flow;

connecting said at least two discharge port openings to enable the circulation of said at least first and second blood fluid streams through said blood pumping system;

rotating a first shaft mounted for rotation relative to said housing about a primary axis, wherein at least a portion of said first shaft extends through said housing wall;

rotating at least one primary vane disposed within the interior of the housing that rotates about said primary axis;

providing at least one secondary vane disposed within the interior of the housing and mounted to said primary vane on a first pivotal axis; and

rotating said primary vane about said primary axis with said secondary vane pivotally oscillating between alternating relatively open and closed positions with respect to said primary vane, the housing, the primary vane, and the secondary vane defining a at least first and second fluid chambers for containing fluid within the housing interior having volumes that vary as the primary vane is rotated

about the primary axis, said first and second blood fluid streams being inputted into said first and second fluid chambers, respectively.

123. The method for circulating at least one blood fluid through a living organism in a pulsatile manner of claim 57 wherein said at least one blood fluid is held temporarily in said at least one fluid chamber during the time interval in which said secondary vane has just approached the relatively open position with respect to said primary vane and before said secondary vane moves toward the relatively closed position with respect to said primary vane.